REMARKS

Applicants acknowledge the 1st Action of 4 JUNE 2003 and request reconsideration of the claims as amended. Before proceeding to a discussion of the references, a review of certain significant features of the invention may facilitate comparisons.

The present invention is directed to using a digital controller to adjust the RPM of an electric motor toward a value which stands in a *predetermined mathematical relationship* to an applied **target frequency f_s**. For this purpose, one executes, in time-overlapping fashion, the following steps:

a) in a first time segment, *whose length is determined by the rotation frequency to be measured*, one calculates a first numerical value characterizing the actual instantaneous RPM of the motor;

b) in a second time segment, *whose length is determined by the target frequency to be measured*, one calculates a second numerical value characterizing the target frequency; and

c) with the help of these two numerical values, one adjusts the RPM of the motor toward a value which stands in a predetermined mathematical relationship to the applied target frequency.

This is shown, for example in FIG. 7. At lower right, the actual RPM, in the form of a rotation frequency **f** (from FIG. 6A, the tachogenerator 138), is applied to a measurement element 147 and this is used in element 149 to calculate a value **n** characterizing the actual RPM of the motor.

Further in FIG. 7, from the left, the **target frequency f_s** is applied to measurement element 141 and, in element 143, a numerical value **n_s** is calculated, which characterizes this target frequency.

In any given measurement cycle, it is a matter of chance, which of steps (a) and (b) is performed first, and this can vary from one cycle to the next.

Next, in element 145, the numerical value **n_s** is multiplied by a factor X, and in element 145', the numerical value n is multiplied by a factor Y. From these two multiplied values, a control difference RGL_DIFF is formed, and this value is applied to a PI-controller 153. The output signal of the PI-controller so adjusts the current to motor 137, that its rotation frequency comes into the predetermined mathematical relationship to the applied target frequency f_s.

FIG. 11 shows how the aforementioned numerical values are determined in an overlapping manner:

at top, the target frequency **f_s** is measured between two falling edges of the signal, in a time window between two events of the signal **f_s**;

below, the value **f**, representing the actual RPM value **n**, is measured between two falling edges of the signal **f**, in a time window between two events of the signal **f**;

The time windows *overlap* each other, so that the two measurements are taken *substantially simultaneously*, which is desirable since the RPM is supposed to be controlled by the

target frequency.

The gist of the invention is to adjust motor RPM in accordance with an applied target frequency **f_s**, e.g. as shown in FIG. 26, in which a single target frequency is used to control three motors 181, 183, 185 of differing structures. Since these motors have different respective numbers of poles, one uses a different factor X for each individual motor, so that the end result is that the motors run equally fast. This is described in the text accompanying FIG. 26.

A different use is, as shown in FIG. 28, to have a motor M1 specify the RPM targets for other motors M2 and M3 so that, when M1 runs slowly, motors M2 and M3 also run slowly while, when M1 runs fast, M2 and M3 also run fast. Thus, one could call the present invention an "electronic gearbox."

One could also adjust two motors so that they run with respective RPMs which differ from each other by, say, 0.1%, meaning that one motor always runs a little quicker than the other, whether they are both fast, or both slow. This would be a harder and more expensive task to accomplish with a mechanical gearbox or transmission.

CLAIM REJECTION -- SECTION 112

Responsive to Page 2 of the 1st Action, the claims have been reworded for greater clarity and better antecedent basis. Claim 58 **is** meant to be dependent upon claim 46.
In particular, independent claims 42 and 62 have been substantially reworded, with some steps (a)-(g) which were

formerly recited in claim 62 having been moved into new dependent claim 100.

CLAIM REJECTION: DOUBLE-PATENTING

Paragraph 3 rejected claims 62-69 for obviousness-type double-patenting, based on commonly assigned DIETERLE+/PAPST USP 6,496,786 in view of HOKARI/FUJI XEROX USP 5,737,216.

Procedurally, it is not understood how USP 6,496,786 can be an effective reference against the present application, having a PCT international filing date of **5 AUG. 2000** when USP 6,496,786 has a later U.S. filing date of **19 SEP. 2000**. Both the present application and USP 6,496,786 claim priority from the same German application **199 45 313** of 22 SEP. 1999, while the present application additionally claims priority from German (CIP) application **199 49 693**, filed three weeks later on 15 OCT. 1999. Further, MPEP section 804.01 states "A prior art reference that renders claimed subject matter obvious under 35 USC 102(e)/103(a) **does not** create a double patenting situation where **that subject matter** is not claimed in the reference patent." The Office concedes that claim 62 recites features not recited in claim 14 of USP 6,496,786, and dependent claims 63-69 incorporate by reference those distinguishing features, and thus **do not** claim the **same subject matter** as dependent claims 15-21 of USP 6,496,786. If the Office needs the additional support of the HOKARI/FUJI XEROX patent to support its obviousness contention, this appears inconsistent with a contention that the **same subject matter** is being claimed in USP 6,496,786 and the present

application. Conversely, if USP 6,496,786 is determined to be "subsequent art" rather than "prior art," HOKARI standing alone does not disclose enough of the features recited in claim 62 to support an obviousness rejection.

Substantively, there are also significant technical differences. DIETERLE USP 6,496,786 relates to a measurement method, according to which the pulses (FIG. 10C) are measured in a time window T_A, but the measurement does not start directly on the left side of this window (location 191); rather, it starts somewhat later at location 197, namely the descending edge of a pulse. The measurement does not end at location 193, the right side of the window, but rather at a location 199, namely the descending edge of a subsequent pulse. The present method, invented by the **same inventive entity** (DIETERLE, HAHN & RAPPENECKER) as in USP 6,496,786, provides more precise frequency measurement.

The present method employs the earlier method as one of its elements, but the earlier DIETERLE method provides **no suggestion** of an overlapping measurement of **two different** frequencies, in order to obtain two numerical values, and also provides **no suggestion** of mathematical processing of these numerical values, and use of the modified numerical values in a digital controller, in order to control the RPM by use of a **target frequency**.

HOKARI/FUJI XEROX (USP 5,737,216) is concerned with the problem of proper color registration in color copiers. When the

registration of the various colors fails to coincide, one gets strange shades not found on the original, as described at col. 12, lines 1-9. This results from the fact that the **cheap** gears used by Fuji Xerox are **too imprecise**, and that **precise** gears are prohibitively **expensive**. FIG. 12 shows such errors and these are described at col. 11, line 48. FIG. 13 shows the result of a Fast Fourier Transform (FFT), cf. col. 11, line 67, where the frequency components, which result from the gear errors, are clearly visible.

For this reason, the color copier, during its manufacture (prior to sale), is driven at a constant RPM (cf. col. 12, line 25 and col. 23, line 22) and for multiple segments of the movement, "rotation speed information" is measured and used to generate a "correction table" (col. 12, line 20). For this purpose, an especially precise encoder 36 is used (col. 18, lines 26-32). This encoder is used **only in the factory**, not provided to customers, and is **not** a part of the copier, but rather is used **only to calibrate** the copier before shipment to the customer.

The stored correction table serves subsequently, during operation of the copier, to obtain better color registration. One of the correction formulas (3), (4) or (5) is used; the example refers to formula (5), which uses these stored data. Thereby, the poor mechanical quality of the gear wheels is supposed to be electronically compensated, cf. col. 23, lines 24-29. A comparison of FIGS. 12 & 18 shows the result of the correction.

Each individual copier is driven, during its manufacture at

the factory, at a constant RPM and is measured/calibrated by the special encoder, the resulting correction values being stored in an individualized correction table in the copier. These data serve to make the poor gear wheels electronically into better gear wheels.

This all has essentially nothing to do with the present invention, since the present invention is not directed to correction data for poor gear wheels, and does not store correction data. HOKARI is directed to a completely different object, namely the individualized correction of a copier, in reaction to the special errors of the gear wheels in this copier, individual results being evaluated differently, cf. col. 5, lines 15-24, and col. 6, lines 13-16.

It is not at all apparent, *what motivation* there would be to *attempt to combine* elements of HOKARI into the DIETERLE USP 6,496,786 mechanism, nor *how* this could be accomplished. The paragraph bridging pages 3-4 of the 1st Action is an assertion based upon hindsight reasoning, attempting to cobble together bits and pieces of two systems which technically would not mesh.

The obviousness rejection of claims 62-69, based on combination of DIETERLE with HOKARI, is not well founded and should be withdrawn. The present invention has no relationship to electronic correction of mechanical errors of gear wheels or to reduction of RPM fluctuations in high frequency portions of photocopiers since, in most applications, the motors described in the present disclosure operate completely without gear wheels.

Instead, the present invention starts with a target frequency, applied to a digital controller, and seeks to control motor RPM in such a way that the motor RPM stands in a predetermined relationship to the applied target frequency. Neither USP 6,496,786 nor HOKARI suggests this invention.

It follows that there is no danger of two patents being in force for the same invention, since different inventions are recited.

CLAIM REJECTION -- SECTION 103

Paragraph 5 of the Action rejected claims 42-43, based on a combination of MIYAKO with HUNTER.

MIYAKO (USP 5,780,984) is directed to the control of the speed of a conveyor belt 3, e.g. how fast a piece of dough 7 is transported through a bake oven in order to bake it. According to FIG. 3, in step S2, a specified transit time t though the oven 4 is predetermined at, e.g. 600 seconds. Within this transit time, a pulse generator must produce a number of pulses, e.g. 6 000 pulses in 600 seconds.

For this purpose, the transit time t is divided into segments of 6 seconds each, and one constantly checks whether the motor was too slow and, if it was too slow, a pilot motor 11 adjusts a transmission 8 so that the motor runs a little faster and, at the end of the 600 seconds, the desired pulse count P results. Thus, if the travel through the oven was too slow at first, the transmission is set faster, so that upon expiration of the time, the desired 6 000 pulses have been obtained.

Conversely, if the motor at first was too slow, the pilot motor 11 adjusts things so that the same criterion is satisfied, that is, **at the end** of the 600 seconds, the 6 000 pulses must have happened.

MIYAKO has no "target frequency" applied; rather the controller obtains only the "global" values P and t. This is like a 20-year old deciding that, at the age of 50, he wants to have a $ 1 million balance in a bank account. It could be that he obtains the entire sum already in his 20th year, but he could equally well obtain it at the age of 49, e.g. from a rich marriage. The "rate" of account increase is not specified by such "global" values.

MIYAKO, according to step S9 in FIG. 3, measures the pulse count and, when this is too low, the apparatus is adjusted to increase the RPM, as shown in S13 in FIG. 3.

It is apparent that, with such an arrangement, one could not use the RPM of one motor to control another, or set the RPM of two motors to differ by 0.1%. For that, the prerequisite is that one specify the actual RPM by applying a target frequency. In the bank account example, this is like saving exactly $ 10 per day.

Further, according to MIYAKO the measurements occur in predetermined rigid measurement periods e.g. every 6 seconds. This could lead to measurement errors since in one period a pulse could be just outside the "window" while in a second period, there could be an extra pulse. According to claims 42 and 62 as

amended, the measurement period is not rigidly defined, but is between two events of the signal, and can "breath" with the signal as its frequency fluctuates.

Only with such flexible or "breathing" measurement can one obtain the exact values for both the actual RPM and the target frequency which ones needs for the "downstream" controlling process. MIYAKO not only fails to suggest this approach, but in fact leads one away from it.

Paragraph 6 of the Action rejects claim 44, based on a combination of MIYAKO with HUNTER and TOYOMURA.

TOYOMURA (USP 6,037,734) discloses an RPM controller. A motor 21 uses an encoder 22 and, using its output signal and a counter (in CPU 46), the interval between two edges is measured. This interval is controlled to a constant value (cf. col. 4, lines 2-4), for example 1 ms, which at a clock frequency of 8 Mhz, corresponds to a count value of 8000 (col. 28, lines 1-14).

If the count value goes over 8000, the motor is too slow and the PI controller (FIG. 16) gives it more current. If the motor is too slow, it gets correspondingly less current.

Due to dividing errors, the intervals between the edges of the encoder signal can fluctuate. If 8000 pulses correspond to a full rotation, a half rotation might be 4200 pulses or only 3800 pulses. This case is shown in FIG. 7.

Therefore, one stores the value 3800 for region w and the value 4200 for the region x, and controls in one region to 3800 and in the other region to 4200. One puts corresponding values

into a working memory 50 (FIG. 3). These values are then **motor-specific**. According to FIG. 9, one calculates the control deviation e' for region 2 according to equation (24) and for region x according to equation (26).

A differing RPM can be specified via a prescaler 41 (FIG. 3). One can adjust to an RPM value which is twice as high or only half as large.

TOYOMURA fails to suggest or make obvious the subject matter of claim 44, and even a combination of MIYAKO with TOYOMURA would not lead to the present invention, even if it were technically possible to achieve.

HUNTER (USP 6,097,564) is directed to generation of a correction or lookup table, but <u>not</u> in the context of a motor, but rather the linear drive 602 for the read/write head 604 (FIG. 6) of a hard disk.

In such a drive, the back-EMF is used for control purposes, and this can be calculated according to various formulas.

The linear drive 602 contains a coil, and this coil has a resistance R_{ACT} and a (low) inductance L_{ACT}, cf. col. 2, lines 26-28. Because L_{ACT} is low, one can neglect this term in the calculation process, but if one uses a constant value for R_{ACT} and calculates the back-EMF as a function of current, one gets the dotted curve shown in FIG. 5, while the real value is illustrated by the upper curve (solid line). The curve with the dots is thus completely misleading, cf. col. 5, lines 45-62.

For this reason, in the embodiment according to FIG. 10, a

correction (lookup) table is measured (col. 14, lines 37-41) and, using this table, one obtains a more accurate characteristic curve of back-EMF as a function of current, as described at col. 14, lines 50-59.

Possibly, the generation of this correction table could be continuously repeated, as mentioned at col. 14, line 60, to col. 15, line 2. In the course of movement of read head 604 (FIG. 6), subsequently in FIG. 10, things go back to OP (Operational Position). For this purpose, for current $I_{act}(t)$, by linear interpolation, an error compensation voltage is calculated, and, with its help, a more precise value for the back-EMF is calculated. This is stated at col. 15, lines 3-11, and col. 20, line 55, through col. 21, line 13.

It seems that the Office has not understood that the present invention is directed to adjusting the RPM of an electric motor to match a value given by a **target frequency**. This has nothing to do with the generation or evaluation of correction tables.

As far as Applicants are aware, using a digital controller to control the RPM of an electric motor **toward a target frequency** was not previously implemented, so perhaps this accounts for the apparent failure of the Office to understand what is being claimed.

AN EXAMPLE TO FACILITATE UNDERSTANDING

According to the present invention, a target frequency of 1500 Hz could correspond to a rotation speed of 1500 RPM, a target frequency of 1800 Hz could correspond to a rotation speed

of 1800 RPM, etc. or one could so adjust the controller that a target frequency of 1500 Hz corresponds to an RPM of 1500 x 0.9 = 1350 RPM, a target frequency of 1800 corresponding to an RPM of 1800 x 0.9 = 1620 RPM, to give only two simple examples. The mathematical relationship could be more complicated; there are no limits to the technical imagination.

None of the cited references teaches anything in this direction, nowhere is the RPM of a motor controlled according to **a frequency**, which is technically difficult since the RPM must follow every frequency change. Even a combination of all the references, if it could be accomplished, would not result in such a method and such an apparatus.

In view of the foregoing amendments and arguments, it is respectfully submitted that the present claims 42-100, as amended, are clear and patentably distinguish over HOKARI, MIYAKO, HUNTER, and TOYOMURA, taken singly or in combination. USP 6,496,786 is not prior art and, in any case, does not disclose the improvements now being claimed. Therefore, withdrawal of the double-patenting and obviousness rejections, and passage of the application to issue, are solicited.

If the examiner detects any remaining informalities, or wishes to suggest any changes to place the application in condition for allowance, a telephone call to the undersigned is invited. A check for the additional claims fees is enclosed; charge any deficiency, or credit any overpayment, to Deposit Account 23-0442.

Respectfully submitted,

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